Active Project (2016 - 2018)

Autonomous, Safe Take-Off and Landing Operations for Unmanned Aerial Vehicles in the National Airspace, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Unmanned aerial systems (UAS) have the potential to significantly impact modern society. While the technology for unmanned air vehicles operating day in and day out without constant human supervision is maturing steadily, much remains to be done to make these vehicles commonplace. We have identified a number of challenges that must be addressed for these vehicles to safely and efficiently conduct their tasks in the National Airspace System (NAS). Civilian applications of UAS must ensure that they can: (1) fly safely without an operator, using but not relying on maps or GPS to guide their course; and (2) deal with contingencies, especially rare events such as complete failure of sensors that provide awareness of the environment. We plan to address these challenges in the context of small, low-cost air vehicles in a manner that will enable our technology to be widely adopted. In Phase I we have demonstrated GPS-free navigation and environmental mapping in real time on a kilogram-scale sensing and computing payload for a small multi-rotor aircraft. The demonstration was noteworthy because it was conducted in complex environments in which GPS signals are blocked or degraded by multipath. In Phase II we propose to extend GPS-free navigation to a larger set of operating environments and to show collision-free guidance from take-off to landing with emphasis on the phases at low altitudes. We will work with the UTM team at NASA Ames to coordinate our experiments on block 4 testing. We expect to show in this program that it is possible for small autonomous air vehicles to reliably and safely fly in the first and last 50 feet of operation.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Safe and robust flight and landing are of great application to NASA. On the air side, the

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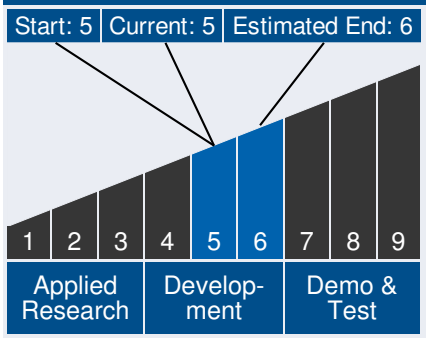
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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proposed technology can be refactored as a safety aid for aircraft that must operate in degraded visual environments or in unprepared sites, providing information to a human pilot. On the space side, NASA has enduring interests in low-form factor sensing that could be applied to landers. Additionally, Near Earth's technology will provide an enhanced capability, enabling more comprehensive UAS flight-testing for NASA's collaborative efforts with the FAA to accommodate UAS operations in the NAS. As the capabilities mature and are integrated into more air vehicles, they will also be of direct use to NASA in their flight testing of navigational aids and guidance systems located in remote areas. The proposed autonomous technology will enable greater utilization of UAS in other NASA areas, particularly for experimentation and testing, for example expanding the utilization of UAS in the Ames FINESSE volcano research. The technology will ultimately enable greater use of UAS in space. A UAS that knows its position and is able to set down and avoid obstacles in a cluttered environment can be used for repairs inside and outside a spacecraft and perform exploration of planetary surfaces. The successful development of the technology specified in this solicitation will enable NASA and its contractors involved with autonomous systems to accomplish testing with increased safety and decreased cost.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The UAS market is forecast to require hundreds-of-thousands of units within just a few years of the FAA establishing the appropriate regulatory procedures for the operation of UAS in the NAS. An enhanced capability for safe and robust autonomous take-off and landing will fuel the market's forecast growth. Technology ensuring the safe operation of UAS, particularly during the first and last 50 ft of flight, will contribute to testing that verifies the safety of UAS operations as well as providing regulators, legislators, and the general public with increased confidence in UAS operations. UAS are already in high demand, and they are being used in an

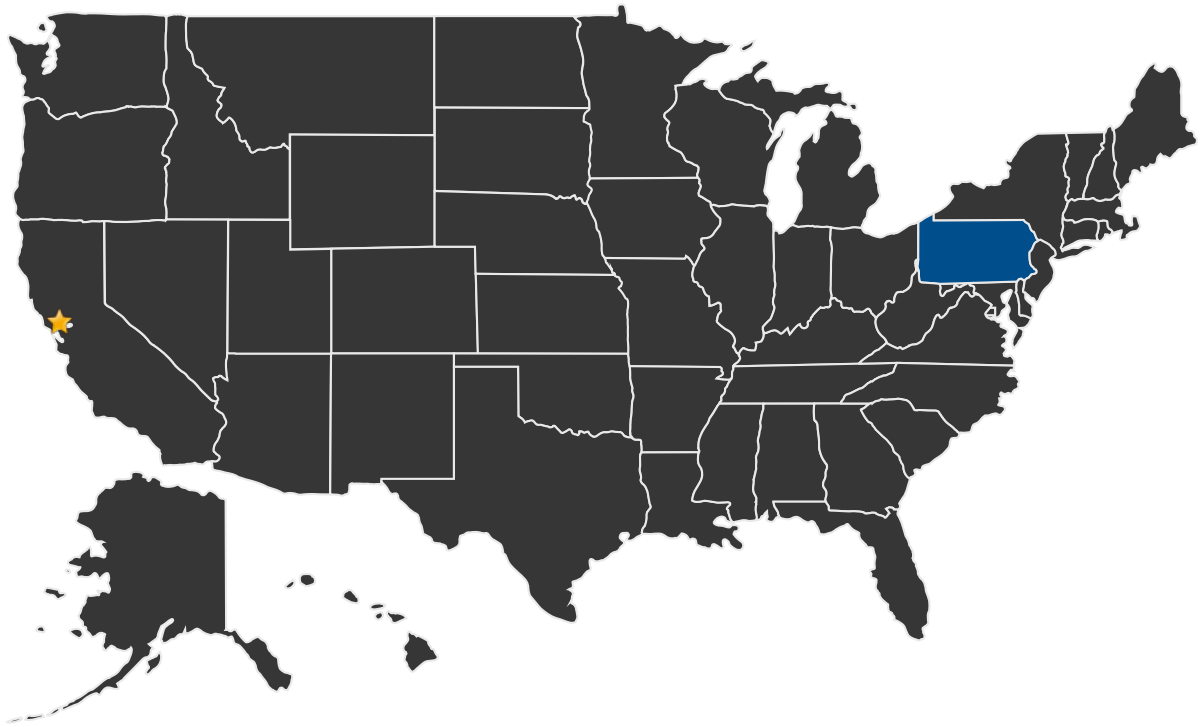
Management Team *(cont.)*

Program Manager:
- Carlos Torrez

Principal Investigator:
- Sanjiv Singh

increasing number of applications. Military UAS requirements are well documented and tens-of-thousands of UAS are already in use worldwide. The ability to take-off and land in tactical cluttered environments will allow UAS to be used more extensively in support of forward units. Additionally, the commercial market is forecast to grow to as many as 160,000 UAS. As soon as UAS operation in the national airspace is fully implemented, the cargo transportation market, in particular, is forecast to be the largest market segment. Autonomous precision take-off and landing will be a key enabling technology in realizing this market.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Near Earth Autonomy, Inc. (Pittsburgh, PA)

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PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23431)

IMAGE GALLERY

Autonomous, Safe Take-Off and Landing Operations for Unmanned Aerial Vehicles in the National Airspace, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

Autonomous, Safe Take-Off and Landing Operations for Unmanned Aerial Vehicles in the National Airspace, Phase II

Potential Applications

Safe and robust flight and landing are of great application to NASA. On the air side, the proposed technology can be refactored as a safety aid for aircraft that must operate in degraded visual environments or in unprepared sites, providing information to a human pilot. On the space side, NASA has enduring interests in low-form factor sensing that could be applied to landers. Additionally, Near Earth's technology will provide an enhanced capability, enabling more comprehensive UAS flight-testing for NASA's collaborative efforts with the FAA to accommodate UAS operations in the NAS. As the capabilities mature and are integrated into more air vehicles, they will also be of direct use to NASA in their flight testing of navigational aids and guidance systems located in remote areas. The proposed autonomous technology will enable greater utilization of UAS in other NASA areas, particularly for experimentation and testing, for example

expanding the utilization of UAS in the Ames FINESSE volcano research. The technology will ultimately enable greater use of UAS in space. A UAS that knows its position and is able to set down and avoid obstacles in a cluttered environment can be used for repairs inside and outside a spacecraft and perform exploration of planetary surfaces. The successful development of the technology specified in this solicitation will enable NASA and its contractors involved with autonomous systems to accomplish testing with increased safety and decreased cost.